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ABSTRACT

The development of an interactive computer model at the University of Kansas and its potential to promote administrative involvement in sophisticated model development and to increase the effectiveness of institutional planning is considered. The model was developed to provide administrators a tool for analyzing the interaction of predicted enrollments with alternative staff, workload, and funding policies. The multiyear model, the Interactive Model of University Resources, is based on the assumption that students will demand a certain number of credit hours in various disciplines. Key outputs of the model include a comparison of faculty salary funding with salary costs and a display of the student credit hours (SCH) demanded by students versus the supply of SCH available given the existing number of faculty and established teaching loads. Among the parameters that were used to develop the model are: levels of instruction, types of faculty, and average faculty salaries by discipline by faculty type. An interim solution to meet the data requirements of the model and other analytical efforts involved using data in the personnel/payroll, student records, and other data bases and files. When beginning a simulation with the model, the user must select policies and assumptions from displayed menus such as enrollment protection technique and faculty attrition rate. The user can then choose the manual or automatic mode. In the manual mode, the user can vary the mix of faculty and workloads for each discipline for each year. In the automatic mode the user can choose whether the model will adjust faculty mix or workload to balance SCH supply to demand. A simplified version of the basic program algorithm for each discipline for a single year is diagramed. (SW)

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Promoting a Planning Dialogue:

A Role for Resource Models

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THE ASSOCIATION FOR INSTITUTIONAL RESEARCH

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Mary Corcoran
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Abstract

Sophisticated planning models and management information systems have been readily available to higher education decision makers for several years. These tools have yet to be fully exploited by administrators despite the fact that declining enrollments and inflation should have increased the demand for higher education planning efforts and decision-influencing information. An alternative approach involves the use of a relatively simple model to stimulate dialogue among administrators, planners, and researchers and to subsequently focus more sophisticated follow-up modeling and information gathering efforts. This paper describes an interactive computer model which relates the variables surrounding decisions involving faculty, funding and enrollments.

Introduction

Sophisticated planning models and management information systems have been readily available to higher education decision makers for several years. These tools have yet to be fully exploited by administrators despite the fact that declining enrollment and inflation should have increased the demands for higher education planning efforts and decision-influencing information. Among the reasons advanced for the slow adoption of planning models are:

1. the models have been too simple (imprecise results, tenuous assumptions);
2. the models have been too complex (massive support data, incomprehensible logic);
3. the question to be addressed by the model has been poorly defined;
4. higher education administrators have relatively high turnover;
5. administrators have been uneasy with quantitative methods; and
6. political management of the model development has been poor (overly exuberant promotion of the model's capabilities, premature release of the results).

The specification and development of management information systems have been hampered by many of these same problems plus expense, long lead times, and the lack of integration of existing operational systems.

An appropriately selected planning model can be used to alleviate some of the aforementioned problems. The question to be addressed by the model must be central to the operation of the university so that the results will be of interest to a diverse group of administrators. The theory behind the first iteration of the model must be simple so as to inspire the confidence of those who are not at ease using the models. If appropriately managed, this first use of the model should lead to more sophisticated follow-up modeling efforts. The data selected to support the model and the administrators' conceptualization of

the relationships between these data should also be of value to management information systems designers and data administrators. This paper will discuss the development of a specific interactive computer model at the University of Kansas and its potential to promote administrative involvement in sophisticated model development and to increase the effectiveness of institutional planning.

Why Was A Model Developed?

In the spring of 1976 it became clear to the administration of the College of Liberal Arts and Sciences that declining enrollments in departments in which a large proportion of the faculty had tenure could be a significant problem in the near future. Was sufficient staffing and funding flexibility available to deal with potential significant drops in demand for the services of some faculty and significant increases in demand for others? A team composed of a college associate dean (mathematics), a faculty member (economics), and two institutional researchers (M.B.A.s) was formed to examine this issue.

The team decided to develop a computer-based model which would provide administrators with a hands-on tool for analyzing the interaction of predicted enrollments with alternative staff, workload and funding policies. Called IMUR, Interactive Model of University Resources, the multiyear model would be based on the assumption that students will demand a certain number of credit hours in various disciplines. It is the challenge of the university to meet this demand constrained by available faculty, teaching loads, funding and tenure.

Building A Model

In developing a model several considerations are paramount. Some questions to ask include:

1. What is the purpose of the model and what kind of questions are to be answered?
2. What levels of detail and precision are required to respond to the questions and to insure confidence in the results?

3. How flexible must the model be to deal with new questions, data and relationships?
4. What data are available to support the model?
5. Who will be involved in defining the model and who will make the final decisions about the content and operation of the model?

With these considerations in mind, the team determined that one important output of the model would be a display of the student credit hours (SCH) demanded by students versus the supply of SCH available given the existing number of faculty and established teaching loads. Another key output of the model would be the comparison of faculty salary funding with salary costs. The ability to vary number of faculty (FTE), faculty workloads, funding assumptions and cost assumptions each year was an essential requirement of the model to allow exploration of alternative policies. To meet the test of flexibility, the model would be constructed from modules which could be changed or updated individually without destroying the integrity of the rest of the model.

Where feasible, the team selected traditional parameters and used historical data patterns to develop the model. The selected parameters included such items as four course levels of instruction (lower level undergraduate, upper level undergraduate, master's and doctoral); four types of faculty (tenured faculty, tenure-track {probationary} faculty, student teaching assistants, and all other, such as lecturers and instructors); and average faculty salaries by discipline by faculty type. Two areas which were discussed extensively were: 1) at what level of aggregation should instruction be analyzed, and 2) how will faculty effort and SCH be linked to determine faculty teaching loads.

There has been much debate about the level of aggregation at which instruction can be meaningfully analyzed. The model was developed at the discipline rather than the departmental level. The Higher Education General Information (HEGIS) taxonomy was used to aggregate departments into such disciplines as

social sciences, physical sciences, education, etc. It was argued that these aggregations were sufficient for discerning trends and that the departmental enrollment trends within a discipline would be similar. However, budget, tenure and other decisions are made at the department level, not at the discipline level. Small departments are special problems in that small numbers can confound meaningful projections. Data are being gathered which will enable the model to operate at the departmental level also.

Determining faculty teaching loads has been the most difficult task in developing the model. The inability to allocate faculty effort to courses has long been the stumbling block to cost analysis in higher education. Initially a Faculty Activity Analysis (FAA) was used. In the FAA, faculty reported their effort for individual courses and then an average course load (SCH per FTE) was calculated by course level and by department/discipline. However, since the University of Kansas does not conduct a FAA on a regular basis (the latest available figures are for 1974), this was found to be an inadequate solution. Eventually a standard course weighting system was used to allocate faculty effort to courses. The weighting system considers type of class (lecture, lab, individual research, activity, etc.) class size, course level, credit hours, and contact hours.

Data To Support The Model

After defining the basic operation of the model and cursorily identifying the data to be included in the model, the team began to define the precise data needed and locate an appropriate source of these data. This was not an easy task because of the state of the administrative information systems at that stage in the project. The university was in the process of converting all its administrative systems from hardware shared with academic computing to separate hardware and software of another vendor. The student credit hour information

(SCH demand, teaching loads) was located on the new administrative computer while the financial data (faculty salaries and FTE) were located on the academic computer.

To further compound the problem, even data common to the two systems were not always consistent. The primary reason for these inconsistencies was that data in each system were defined and updated solely for the operational use of a specific user. Also the systems were developed at different times during an eight-year span with the attendant changes in personnel, system requirements, and information systems state of the art.

An interim solution to meet the data requirements of the model and other analytical efforts was obviously necessary until problems with the systems are resolved. The interim solution agreed upon involves taking extracts of key data in the personnel/payroll, student records, and other data bases and files at specified times each semester and storing these on tape.

Design of IMUR

Figure 1 outlines the basic operation of IMUR. When beginning a simulation with the model, the user must select policies and assumptions from displayed menus such as enrollment projection technique, inflation rates, and faculty attrition rate. These policies are in effect for all years of the specific simulation session. At this point the user can choose the "manual" or "automatic" mode. In the manual mode the user can vary the mix of faculty and workloads for each discipline for each year. In the automatic mode the user can choose whether the model will adjust faculty mix or workload to balance SCH supply to demand. In either mode a variety of summary displays can be selected for each year.

Figure 2 displays a simplified version of the basic program algorithm for each discipline for a single year. The key comparisons are SCH supply versus demand and salary costs versus funding. An important contributor to the

FIGURE 1. IMUR - BASIC OUTLINE OF THE MODEL

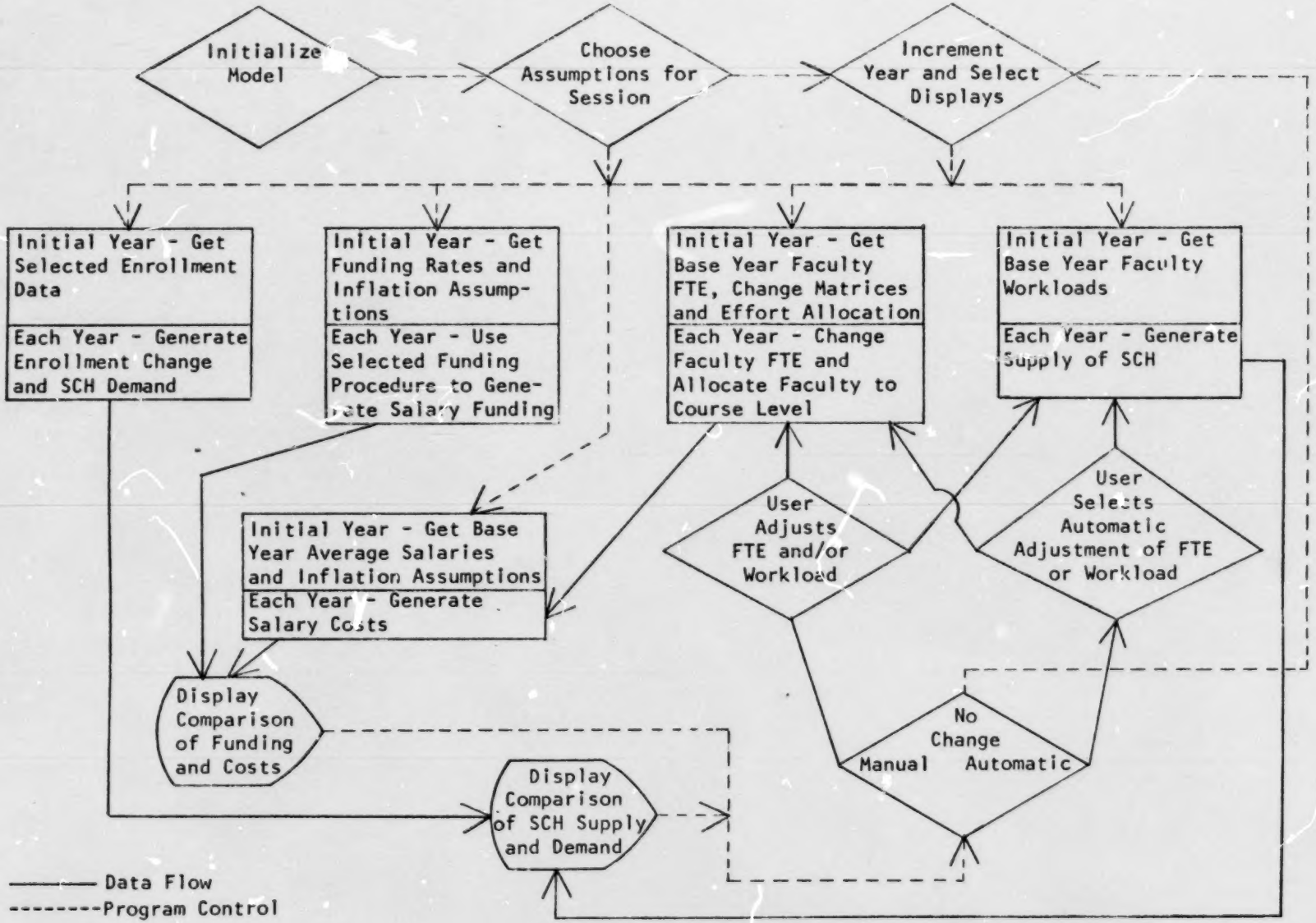
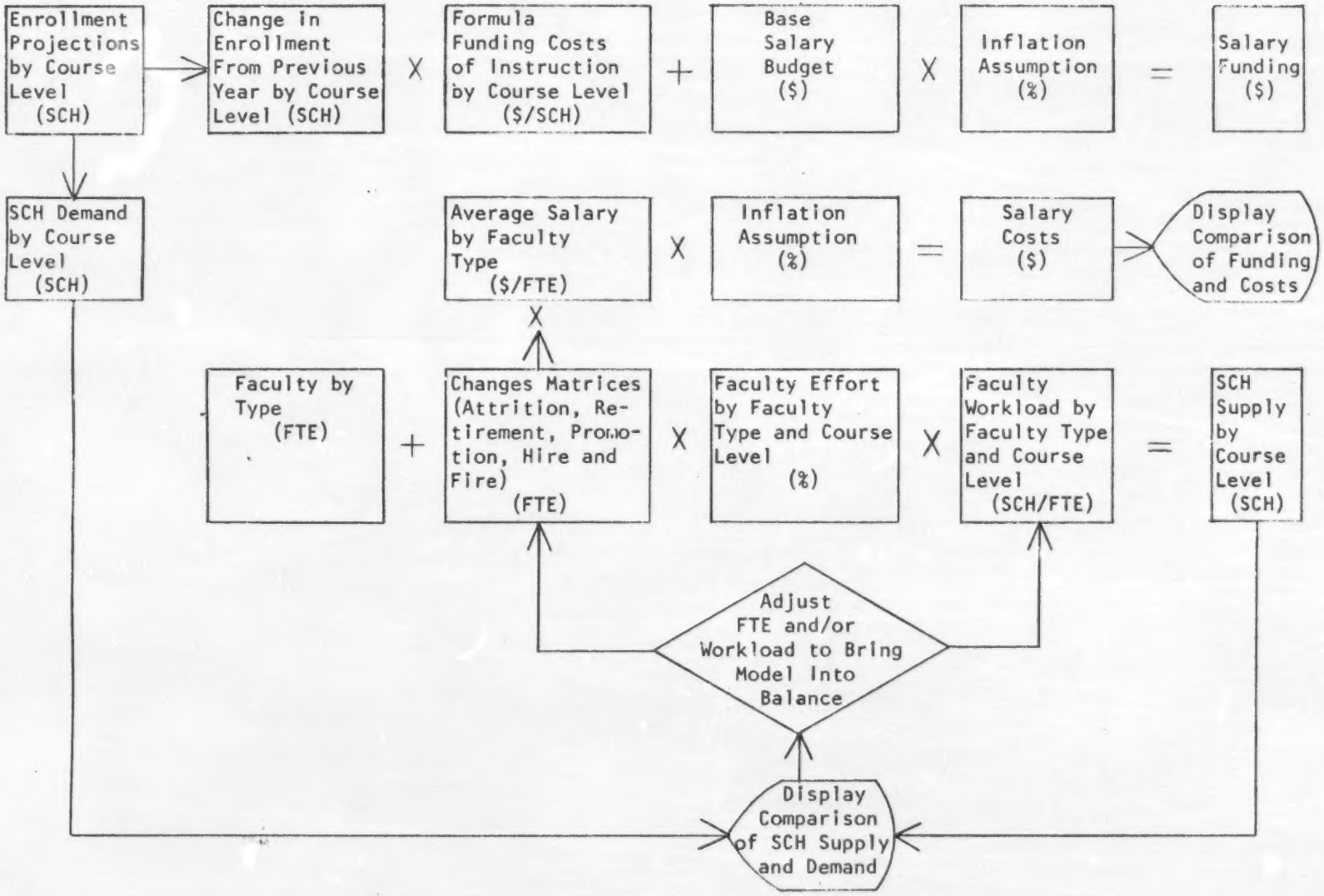

Initialize Model
Choose Assumptions for Session
Increment Year and Select Displays
Initial Year - Get Selected Enrollment Data
Each Year - Generate Enrollment Change and SCH Demand
Initial Year - Get Funding Rates and Inflation Assumptions
Each Year - Use Selected Funding Procedure to Generate Salary Funding
Initial Year - Get Base Year Faculty FTE, Change Matrices and Effort Allocation
Each Year - Change Faculty FTE and Allocate Faculty to Course Level
Initial Year - Get Base Year Faculty Workloads
Each Year - Generate Supply of SCH
Initial Year - Get Base Year Average Salaries and Inflation Assumptions
Each Year - Generate Salary Costs
User Adjusts FTE and/or Workload
User Selects Automatic Adjustment of FTE or Workload
Display Comparison of Funding and Costs
Display Comparison of SCH Supply and Demand
No Change
Manual
Automatic
Data Flow
Program Control

FIGURE 2. :MUR - BASIC ALGORITHM FOR ONE DISCIPLINE FOR A SINGLE YEAR


Enrollment Projections by Course Level (SCH)
Change in Enrollment From Previous Year by Course Level (SCH)
X
Formula Funding Costs of Instruction by Course Level ($/SCH)
+
Base Salary Budget ($)
X
Inflation Assumption (%)
=
Salary Funding ($)
SCH Demand by Course Level (SCH)
Average Salary by Faculty Type ($/FTE)
X
Inflation Assumption (%)
=
Salary Costs ($)
Display Comparison of Funding and Costs
X
Faculty by Type (FTE)
+
Changes Matrices (Attrition, Retirement, Promotion, Hire and Fire) (FTE)
X
Faculty Effort by Faculty Type and Course Level (%)
X
Faculty Workload by Faculty Type and Course Level (SCH/FTE)
=
SCH Supply by Course Level (SCH)
Adjust FTE and/or Workload to Bring Model Into Balance
Display Comparison of SCH Supply and Demand

flexibility of the model is the faculty FTE change matrix. It is relatively easy to include any number of new matrices which may be discontinuous functions (e.g., actual retirements) or linear functions (e.g., attrition rates). Also all automatic and manual adjustments of faculty mix are made through a change matrix. The data required to drive the model include historic SCH, faculty salaries, faculty FTE, faculty workloads, faculty effort allocations, funding formula, faculty attrition, faculty retirements, and tenure rates.

In its current configuration, the model takes the selected enrollment projection, funding alternative, and inflation assumptions; the historic changes to faculty mix; the calculated faculty allocation and workloads; and the FY 1978 average salaries and base salary budgets and then projects faculty mix, faculty workloads, SCH supply and demand, salary funding and salary costs by discipline. The model currently uses FY 1978 as the base year and includes actual SCH and inflationary increases for FY 1979 and FY 1980. The model projects five years, FY 1981 to FY 1985.

Next Steps

Our experience with the model to date leads us to feel that a major decision with respect to the operation of the model will have to be made soon. As the model has grown in complexity, the amount of time necessary to complete one modeling session has increased significantly. The dilemma we face involves whether or not to maintain a "hands-on" capability for those who desire it while increasing the level of model detail.

Reducing the number of display choices, making more of the matrices into precalculated files, using higher speed CRTs and modems, and reducing the scope of each modeling session (one discipline or department at a time) would enhance the speed of the model. However, these gains would be more than off-set by the addition of beneficial but time-consuming capabilities such as linear programming solutions or the addition of major new variables such as support staff,

other operating expenses, and floor space. The ultimate solution may be two models: one simple model for administrators which operates at relatively high degrees of aggregation, and a second model which would be used by institutional researchers at the direction of administrators to model more disaggregated data with more sophisticated techniques. The use of commercially available packages such as EDUCOM's Financial Planning Model (EFPM) and other more general data mangers and modeling languages is being explored.

While the model has been operational for some time, its use has been limited. Contributing to this "limited use" are the data required by the model. It is a time consuming process to gather the data, particularly since the model has been a moving target until recently when the problem of allocating faculty effort to courses was resolved using a standard weighting system. We are currently gathering data for FY 1980 and anticipate having the model operating with that data set by mid-summer.

Furthermore, while this development was undertaken at the request of the management of the College of Liberal Arts and Sciences, other senior administrators have been skeptical of using models for planning purposes. However, in discussing the merits of models in planning, a dialogue about planning assumptions, needs and expectations was initiated. Heretofore that kind of discussion had been limited to the lofty goals of the University rather than the nuts and bolts of accomplishing stated objectives.

These discussions combined with financial crises/exigency in sister institutions has led to a more active interest and participation in planning by senior administrators. We anticipate that IMUR will be successful in addressing the specific question responsible for its creation: Does the University of Kansas have sufficient staffing and financial flexibility to meet anticipated enrollment changes? Yet the ultimate value of the model may not be its projections related to this specific question but the stimulation of a planning

dialogue. The dialogue established during the specification, design and first use of planning models should provide the impetus for productive and on-going discussions of the present and future policies, plans and information needs of the institution.